NOT FOR PUBLICATION

# FOREST RESEARCH BRANCH

# ANNUAL REPORT

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# DIRECTOR'S REPORT

The past fiscal year was a challenging year. Due to position classification difficulties Dr. Navratil decided to return to Lakehead University in May. However, we were lucky to retain him on contract to guide our reforestation research during the summer months. He finally returned to the Branch in early January in 1985 on a long-term contract. Our recruitment efforts to fill the position of Site Classification Manager remained unsuccessful. Despite these recruiting difficulties all programs were not only maintained but several of them were significantly advanced. This progress was only possible with the proper combination of in-house research with contract and grant research, and most importantly with highly motivated and dedicated staff.

Nursery research results indicated that dormancy of seedlings can be predicted fairly accurately. The study concerning the extension of planting season revealed that continuous planting or "hot-planting" may be carried out quite successfully only with spruce, provided certain precautions are taken with storage of the seedlings. There is every indication that microsite selection for planting is just as important in Alberta as it is elsewhere for successful seedling establishment and subsequent growth.

The peatland drainage results were one of the highlights of research accomplishments, demonstrating that the

application of synthetic hydrographs provides a sound basis for the design of ditch spacing. The constructed ditches worked very well, drawing the water table to an average depth of 33 cm compared to the planned 40 cm. Phenological studies related to the height growth of various species grown in the drained and undrained peatland were initiated, and the establishment of long-term permanent sample plots was also carried out.

Good progress was made on the analysis and synthesis of fear response producing chemicals for snowshoe hare. These may become very important tools for the protection of our young forests.

A novel method has been developed by one of our contract researchers for the economic production of pheromones which are used for the detection and trapping of mountain pine beetles.

Watershed research also advanced considerably in the past year. An ambitious program was developed for the completion of the Tri Creeks Experimental Watershed Study in cooperation with the Alberta Research Council, Universities, Canadian Forestry Service, Alberta Environmental Centre Vegreville, Edson Forest, Forest Technology School, Fish and Wildlife Division, Resource Evaluation and Planning Division and St. Regis (Alberta) Ltd.

During our busy schedule we found time to attend several forester's and ranger's meetings where our research programs were explained. Several papers were presented at various scientific meetings and symposia and a successful site classification course was organized at Hinton in co-operation with REAP and the Forest Technology School.

Two major reports were published. One covered forest research in Alberta and the other provided descriptions of major plant associations in the northern subalpine zone in Alberta.

J. Soos
Director

## 1.0 REGENERATION STUDIES

The research program in Regeneration/Silviculture concentrates on two main areas: enhancement of planting stock quality, and optimization of plantation establishment. Projects addressing concerns in these two areas were initiated in 1982 and 1983, and continued in 1984. The in-house program was supplemented by contractual studies.

The Reforestation and Reclamation Branch continued support of the program, and the Investigation Section of the Pine Ridge Forest Nursery actively cooperated in nursery-oriented projects.

### 1.1 DETERMINATION OF OPTIMAL LIFTING WINDOWS FOR OVERWINTER STORAGE OF WHITE SPRUCE AND LODGEPOLE PINE BARE-ROOT STOCK

**JUSTIFICATION:** The physiological condition of seedlings that are lifted for storage during the winter prior to planting critically affects the quality of the seedlings, and thus their survival and growth after planting. Reliable criteria for estimating safe lifting times are not available, and therefore need to be developed.

**INVESTIGATOR:** Dr. S. Navratil, Forest Research Branch

**OBJECTIVES:** Determine safe lifting windows for white spruce and lodgepole pine for over-winter storage.

Design of criteria for estimating the readiness for lifting and the storability of the seedlings.

Assess the effects of nursery practices on the storability of bare-root seedlings.

**ACHIEVEMENTS:** Analyses of the 1982 and 1983 results indicate that lifting time was more critical for lodgepole pine than for white spruce. For white spruce lifted in 1983, best overall seedling quality and storability was exhibited when the seedlings were lifted after October 12. The accumulated chilling sum ($\leq 5^{o}C$) of 300 hours was reached in the first week of October. Lodgepole pine required approximately an additional week in 1983 to be ready for lifting.

The root growth indicator based on counting of white root tips was a good predictor of the beginning of the safe lifting window.

Late season foliar application of micronutrients did not improve the storability of seedlings.

Field outplanting trials of the sequentially lifted and winter-stored seedlings were established. The lodgepole pine plantation was established in the Grande Prairie Forest, and white spruce was outplanted in the Whitecourt Forest.

An interim report has been prepared, and a paper was presented at a conference.

**FUTURE WORK:** Lifting studies will be continued in 1985, and subsequent greenhouse assays and field outplantings will be carried out.

A study (by contract to the University of Alberta) will be undertaken to simulate the effects of warm daytime temperatures on delaying or reversing dormancy in white spruce seedlings. This study will help determine the validity of using weather and phenological data for prediction of readiness for lifting.

A progress report will be prepared summarizing the results of the data from the first three years. In addition, papers for conferences and for journal publication will be prepared.

## 1.2 EFFECTS OF WRENCHING, UNDERCUTTING, AND LATERAL PRUNING ON THE QUALITY AND POST-PLANTING PERFORMANCE OF BARE-ROOT SEEDLINGS

**JUSTIFICATION:** Wrenching and undercutting of seedlings in nursery beds increases root size and fibrosity, and can improve resistance to stresses and survival after planting. An optimal schedule for the timing and intensity of these operations needs to be developed.

**INVESTIGATORS:** Dr. S. Navratil, Forest Research Branch, and P. Au, Pine Ridge Forest Nursery.

**OBJECTIVES:** Develop operational schedules for wrenching, undercutting, and pruning that would improve the quality of seedlings.

Determine if these nursery practices can be used to increase the resistance of seedlings to storage and handling stresses, improve seedling morphological characteristics, and thus improve post-planting performance.

**ACHIEVEMENTS:** Wrenching treatments and fall lifting of white spruce (3-0) and lodgepole pine (2-0) seedlings were conducted. The morphological features of seedlings were measured, analysed, and related to the intensity and timing of wrenching treatments.

Field trials were established to ascertain the effects of wrenching treatments on survival and growth in plantations.

**FUTURE WORK:** Greenhouse and field outplanting trials will be conducted using the seedlings from the 1984 wrenching treatments. A new wrenching trial with modified treatments will be initiated on white spruce.

A progress report covering two wrenching trials in lodgepole pine and one in white spruce will be prepared. A publication in Tree Planter's Notes is planned.

## 1.3 MYCORRHIZAL INOCULATION OF CONTAINERIZED SEEDLINGS TO IMPROVE SURVIVAL AND GROWTH IN PLANTATIONS

**JUSTIFICATION:** Mycorrhizal inoculation of seedlings offers promise for increasing reforestation success, particularly on suboptimal sites. Seedlings produced in container nurseries frequently lack well-developed mycorrhizae. Compatibility

of selected mycorrhizal fungi with local seed sources and the benefits of inoculations in greenhouse and after outplanting need to be evaluated under local conditions.

INVESTIGATOR: Dr. S. Navratil, Forest Research Branch

OBJECTIVES: Evaluate the efficiency and benefits of mycorrhizal inoculations of containerized white spruce and lodgepole pine seedlings for improving outplanting performance.

Evaluate the effectiveness of several mycorrhizal fungi for seedling inoculation.

ACHIEVEMENTS: Two fungi, Hebeloma and Laccaria, were found to have good potential for mycorrhizal inoculations under the growing conditions of containerized production at the Pine Ridge Forest Nursery. The degree of mycorrhizal formation was found to differ strongly for different seed sources.

Inoculation increased the variability of seedling morphology, in particular root biomass and fibrosity were influenced, along with shoot to root ratio.

Eight plantations of mycorrhizae inoculated seedlings were established in the Edson, Rocky-Clearwater, Whitecourt, Lac La Biche and Athabasca Forests.

A report and a workshop paper on the results of tests of four different mycorrhizal fungi on white spruce and jack/lodgepole pine were prepared.

**FUTURE WORK:** Inoculations of the selected seedlots of containerized lodgepole pine and white spruce will be continued, and the seedlings tested in plantations. Additional mycorrhizal fungi will be tested.

Collection of local, forest site-adapted, strains of mycorrhizal fungi in Alberta will be initiated.

Assessment of existing and new outplanting trials will be continued.

## 1.4 CONTINUOUS PLANTING (HOT-PLANTING) OF FRESHLY LIFTED BARE-ROOT STOCK

**JUSTIFICATION:** Increased reforestation targets require the ability to extend the planting season beyond the traditional spring planting of bare-root stock. New technology needs to be developed to allow continuous planting which is both biologically safe and acceptable in practice.

**INVESTIGATOR:** Dr. S. Navratil, Forest Research Branch

**OBJECTIVES:** Determination of the survival and growth trends of freshly lifted white spruce and lodgepole pine planted throughout the growing season.

Determine the effects of short-term cold storage on survival and growth of "hot-planted" stock.

**ACHIEVEMENTS:** Outplanting trials of freshly lifted white spruce and lodgepole pine, started in 1982, were continued through 1984. Plantations of white spruce were established

in the Lac La Biche Forest, and of lodgepole pine in the Whitecourt Forest.

After two years in the field, the survival of white spruce planted bi-weekly from June to October in the lower sub-boreal region was uniformly higher than 90%, with the exception of one planting date. Four-day storage of seedlings, in the upright position in dark, open boxes at +2°C to +4°C did not, or only slightly reduced survival as compared to seedlings stored for one day. Storage for seven days reduced survival.

Height increments in the third year after planting were significantly lower for the seedlings planted after July 15.

FUTURE WORK: Establishment of plantations and monitoring of survival and growth will be continued. An interim progress report will be prepared.

## 1.5 FALL PLANTING OF BARE-ROOT STOCK

JUSTIFICATION: Fall planting of bare-root stock is one of the options available to extend the planting season in order to increase the annual area regenerated. The relation of the success or failure of such fall plantings to the physiological conditions of the seedlings, the time of lifting, and planting and site conditions need to be documented and explained.

**INVESTIGATOR:** Dr. S. Navratil, Forest Research Branch

**OBJECTIVES:** Determine the survival and growth of fall-planted seedlings in relation to lifting and planting dates, and the duration of short-term cold storage.

**ACHIEVEMENTS:** Fall planting trials were started in 1982. To date there have been six plantations established in the Slave Lake, Rocky-Clearwater, Lac La Biche, and Whitecourt Forests. White spruce and lodgepole pine have been planted bi-weekly between mid-August and the first week in October.

Cold storage for periods of one day, two weeks, and four weeks has been tested.

Two-year survival (combined biological mortality and heaving) in the 1982 plantation in the Swan Hills ranged between 70% and 96% for lodgepole pine, and between 65% and 82% for white spruce. For both species the seedlings planted in mid-August had the lowest survival, and those planted at the end of September had the highest survival.

Antitranspirant treatment did not improve the survival rate.

**FUTURE WORK:** Establishment of plantations and monitoring of survival and growth will be continued.

## 1.6 IMPROVING PLANTATION ESTABLISHMENT BY OPTIMIZING MICROSITE CAPACITY ON SITE-PREPARED AREAS

**JUSTIFICATION:** Survival and growth of planted seedlings can be considerably improved by appropriate site preparation. Planting microsites created by site treatments differ in soil temperature, moisture content, aeration, degree of mixing of organic matter, and vegetative competition. The microsites that optimize seedling performance need to be identified and related to different site treatments.

**INVESTIGATOR:** Dr. S. Navratil, Forest Research Branch

**OBJECTIVES:** Define the optimum microsites for planting bare-root and containerized seedlings on mechanically prepared sites.

**ACHIEVEMENTS:** First year survival and growth of white spruce and lodgepole pine seedlings of the microsite planting trials established in 1983 were assessed. The effects of the different microsites on sites prepared by Bräcke and Marttiini on the survival of seedlings one year after planting were pronounced. The elapsed time between site preparation and planting, and the time of planting also influenced and interacted with the effects of microsites on survival. The choice of the optimal microsites will need to be based on an assessment of several characteristics.

**FUTURE WORK:** A series of microsite planting trials will be established on sites prepared by Bräcke and Marttiini plow. Survival and growth of the microsite plantation trials will

continue to be monitored, including those established by the Reforestation and Reclamation Branch in 1983 and 1984. An interim progress report will be prepared.

## 1.7 THE EFFECT OF LIGHT QUALITY ON SEEDLING GROWTH AND SURVIVAL

**JUSTIFICATION:** This study provides information on whether better quality seedlings can be grown in the greenhouse by using different light quality.

**INVESTIGATOR:** Dr. J. Hoddinott, University of Alberta

**OBJECTIVE:** Assess the effect of far-red light treatment on the growth characteristics of lodgepole pine and balsam poplar seedlings.

**ACHIEVEMENTS:** The possibility of better seedling survival following treatment with far-red light was indicated for both species because of a slight increase in the root to shoot ratio.

Far-red light treatment increased internodal extension; and dry matter production of needles, stems, and roots. The increase was due to greater photosynthetic efficiency.

For lodgepole pine seedlings the supplemental far-red light treatments during their three-month growing period increased whole seedling dry weight by 229%, stem dry weight by 459%, and root dry weight by 334%. For balsam poplar

seedlings the same treatment increased whole seedling dry weight by 52%, stem dry weight by 215%, and root dry weight by 107%.

**FUTURE WORK:** Detailed data analysis and preparation of a publication will be carried out.

**FUNDING:** Forest Development Research Trust Fund.

## 1.8 FACTORS AFFECTING FIELD PERFORMANCE OF CONTAINERIZED AND BARE-ROOT STOCK IN ALBERTA

**JUSTIFICATION:** There is no information available in Alberta on the survival and subsequent growth of various size container seedlings. Information is also lacking on the survival and growth of incorrectly planted seedlings, such as those planted too shallow or too deep, or with the roots in the "J" configuration.

**INVESTIGATOR:** N.R. Walker, Canadian Forestry Service

**OBJECTIVES:** Determination of the optimal size for containerized seedlings to be planted in the subalpine zone.

Evaluate the optimal planting depth, the best root position, and the most successful planting tool for bare-root lodgepole pine and white spruce seedlings on various soil types.

**ACHIEVEMENTS:** After three years in the field the survival of containerized lodgepole pine seedlings in clay and loam soils is 90% or better except for those grown in 55 $cm^3$ containers and planted in loam in the fall. These have 81% survival. In organic soil survival ranges from 71% to 100%. Dieback of tops has reduced the heights of all seedlings after the second winter. Lodgepole pine seedlings grown for 13 to 15 months in the greenhouse in containers had only a few green needles at the top few centimeters of the main stem, and no lateral branches.

White spruce containerized seedlings have poor growth on all soils, but the worst is on organic soils. In some cases dieback has resulted in negative growth. Frost heaving of the root plugs has been serious on all soils, but worst on organic soils.

There are no apparent survival differences between bare-root lodgepole pine planted with either a bar or a mattock after three years. Shallow planting has had the poorest survival rate on all soil types. In spite of some top dieback there has been height growth in all classes and on all soil types. Top dieback appears to be due to climatic effects rather than in response to soil types.

Bare-root white spruce plantations do not exhibit differences between planting with a bar or a mattock. Survival of shallow-planted stock has been poor only on organic soils, but on all soils these seedlings have exhibited poor stability. Some seedlings are lying flat on the ground with roots exposed. Growth at the end of three years has

been poor, with a high percentage of dead tops found on clay soils, probably due to climatic factors.

**FUTURE WORK:** Survival and growth of the plantations will continue to be monitored.

**FUNDING:** Contract funding from the Forest Research Branch.

## 1.9 FIELD AND GREENHOUSE PERFORMANCE OF WHITE SPRUCE EDAPHIC ECOTYPES

**JUSTIFICATION:** White spruce grow under soil conditions having a wide range of pH. It is necessary to determine if growth performance of seedlings is significantly affected when planted on soils with soil pH different from that of the seed origin. If the difference in growth is significant then cones should be kept separately and seedlings should not be planted on sites where pH is significantly different from that of their source.

**INVESTIGATORS:** Drs. D.J. Pluth and B.P. Dancik, University of Alberta

**OBJECTIVE:** Determination of greenhouse survival and growth of white spruce seedling plantations collected from areas having different soil calcium concentrations.

**ACHIEVEMENTS:** Various progenies were grown in hydroponic

sand cultures with controlled solution composition.

Analyses of soils, needles and the growing medium were carried out.

Preparation of a MSc. thesis is in progress.

**FUTURE WORK:** Data analyses and the preparation of a MSc. thesis will be completed.

**FUNDING:** Forest Development Research Trust Fund

## 1.10 VARIATION OF ANATOMICAL AND PHYSICAL PROPERTIES OF ASPEN IN ALBERTA

**JUSTIFICATION:** When aspen wood is utilized, especially for pulp and paper products, it is important to know the variation of specific gravity and fibre length within a tree, between various clones, and geographic areas.

**INVESTIGATOR:** Dr. M.M. Micko, University of Alberta

**OBJECTIVES:** Establish basic information about the variation of wood specific gravity and fibre length, growth rate and decay in naturally occurring aspen clones in Alberta.

**ACHIEVEMENTS:** Ten aspen clones from the Edson area were studied for their wood quality characteristics. It was found that tree taper and roundness was quite uniform between various clones. However, considerable differences were

observed in growth rate, relative density and fibre length between clones. Relative density showed a characteristic decreasing pattern from the pith towards the bark reaching a minimum between 15 - 20 years and increasing again beyond that age. Relative density was higher at the base and top of the tree while the middle portion of the tree exhibited the lowest density.

The observed ranges of density and fibre length between individual clones were 0.32 to 0.41 and 0.934 to 1.177 mm respectively.

**FUTURE WORK:** The study is completed and a report is prepared.

**FUNDING:** Forest Development Research Trust Fund

## 1.11 STAND DYNAMICS FOLLOWING HARVESTING

**JUSTIFICATION:** There is a perception that stands established after harvesting will be more productive and will reach rotation age sooner than the virgin forest stands. All available growth and yield information was collected in fire origin stands. After regeneration, the long-term growth and yield based on presently used stocking standards will be tested to determine if they produce the results anticipated.

**INVESTIGATOR:** J. Fochler, Forest Research Branch

**OBJECTIVES:** Monitor the development of newly regenerated

forest stands after harvesting until the stands are mature.

Relate the establishment, ingress, mortality and growth of regenerated stands to plant associations of various bio-geoclimatic zones.

**ACHIEVEMENTS:** Twenty-eight plots were established in the Grande Prairie Forest within the Procter and Gamble Cellulose Ltd. FMA. Twenty-three of the plots are located in the upper subzone of the boreal white and black spruce zone (BWBS), and five are in the lower subzones of subalpine Engelmann spruce subalpine fir zone (ESSF). The work was accomplished in cooperation with Resource Evaluation and Planning Division (REAP).

**FUTURE WORK:** Additional permanent sample plots (PSP) will be established in the Swan Hills area and MOF plantations.

A field manual for establishing stand dynamics permanent sample plots will be developed for use in the future.

## 1.12 TESTING OF TIMED-RELEASED BIOLOGICAL REPELLENTS TO CONTROL HARE DAMAGE IN PLANTATIONS IN ALBERTA

**JUSTIFICATION:** It is well known that peak snowshoe hare populations occur at ten-year cycles. Hares cause great damage to young spruce and pine plantations during those years. Therefore it is very important to protect these plantations in an environmentally acceptable manner against hare damage.

**INVESTIGATOR:** Dr. T.P. Sullivan, Northwest Ecological Animal Research Ltd.

**OBJECTIVES:** Collect and test naturally-occurring volatiles produced by predators for control of hare damage in plantations.

Testing of synthesized compounds produced by the University of Calgary.

**ACHIEVEMENTS:** Pen and field tests indicated that the odor of red fox urine and its principle component, 3-methyl-3-butenyl methyl sulfide, discouraged feeding on coniferous tree seedlings by hares. None of the other compounds tested were effective.

Mixtures of 8 and 9 synthetic compounds were ineffectual in pen bioassays, but the mixture of 8 compounds resulted in significant reduction in feeding by hares in field trials.

Pen bioassays of the weasel anal gland secretion 3-propy.-1,2-dithiolane was highly effective in suppressing hare feeding after the compound had over-wintered in the field at Summerland, Vernon, and Langley, British Columbia. Polymerization of the dithiolane appears essential for the compound to be effective.

**FUTURE WORK:** The weasel anal gland secretion 3-propyl-1,2-dithiolane is being tested under northern Alberta field conditions. Tests will also be run on 3-methyl-3-butenyl methyl sulfide as an interspecfic chemical signal to suppress

hare feeding.

**FUNDING:** Contract funding from the Forest Research Branch.

## 1.13 FEAR RESPONSES-PRODUCING CHEMICALS FOR SNOWSHOE HARE (*Lepus americanus*): BIOLOGICAL REPELLENTS TO CONTROL HARE DAMAGE TO FOREST PLANTATIONS IN ALBERTA

**JUSTIFICATION:** It is necessary to produce artificial fear response producing chemicals for testing under pen and field conditions, to assess their effectiveness and longevity for the reduction of hare damage in plantations.

**INVESTIGATORS:** Drs. H. Wieser and E. Dixon, University of Calgary

**OBJECTIVES:** Identify active repellent compounds contained in urine and fecal samples, and anal gland secretions of wolverine, lynx, bobcat, and weasels.

Synthesize the repellent compounds in the quantities required for bioassays, and measure evaporation rates and chemical stability.

**ACHIEVEMENTS:** Five volatile mustelid compounds used for pen and field bioassay trials have been prepared in the quantities required at better than 95% purity. Two additional experimental thiethanes were prepared for future exploratory pen bioassay tests.

Release rate studies were carried out on the weasel anal gland secretions 3-propyl-1,2-dithiolane and 2-propylthietane. The dithiolane sample showed essentially no weight loss over 26 days, and there was no evidence of extensive polymerisation.

A system utilizing gas chromatography has been developed which will allow chemical analysis of the complex natural compounds.

**FUNDING:** Contract funding from the Forest Research Branch.

## 2.0 SITE IMPROVEMENT STUDIES

### 2.1 DESIGN OF A DRAINAGE SYSTEM IN FORESTED PEATLAND WITH SPECIAL REFERENCE TO THE WATER REGIME NEAR SAULTEAUX RIVER, SLAVE LAKE, ALBERTA: PHASE III

**JUSTIFICATION:** Peatland covers approximately 16 million hectares in Alberta. Trees growing in peat normally produce unmerchantable stands due to high water tables which restrict oxygen supply to the roots, and thus prevent the uptake of nutrients even though the nutrients may be available in sufficient supply for normal tree growth. If watertables can be maintained at the proper depth, considerable growth increases can be expected.

**INVESTIGATOR:** Dr. J. Toth, University of Alberta

**OBJECTIVES:** Design a drainage system to enhance tree growth

Addendum: To page 22 concerning 1.13 Project

**FUTURE WORK:** To provide chemical and analytical support and services for the bioassay tests of biological repellents for snowshoe hare conducted by Dr. Sullivan. Identification and synthesis of active repellent compounds contained in urine and fecal samples and anal gland secretions of wolverine, lynx and bobcat will be carried out.

in forested peatland near the Saulteaux River in the Slave Lake Forest.

Evaluate the effect of drainage on the water balance and water quality in the study area.

Develop in-house expertise on the drainage of peatlands.

**ACHIEVEMENTS:** A system known as "Synthetic Hydrograph Optimization" was developed that makes it possible now to design drainage systems for the control of the watertable in peatlands that result in an optimum combination of hydraulic effectiveness and economic efficiency.

Evidence based on hydraulic conductivity values obtained by the piezometer technique indicate that the experimental ditch system was slightly underdesigned.

Nevertheless, an average drainage norm of approximately 0.33 m for a flood duration limit of 14 days has been attained for the summer of 1984, which is only 0.07 m less than that specified as design criterion. Taken together with the observation that the average maximum depth to the water-table in the undrained control plot during the same period was 0.06 m, this clearly indicates the effectiveness of the ditch system.

Water level monitoring was continued and new watertable observation wells were installed. Water samples were collected and chemically analyzed.

In-situ field values of peat hydraulic conductivity and watertable response coefficient of precipitation were

obtained.

**FUTURE WORK:** Data collection will continue at the study site.

**FUNDING:** Contract funding from the Forest Research Branch

## 2.2 EFFECTS OF PEATLAND DRAINAGE AND EARLIER SUBSTRATE HEATING ON PHENOLOGY OF TREES AND SHRUBS

**JUSTIFICATION:** Information is completely lacking on the short- and long-term growth of trees in drained and undrained peatland.

**INVESTIGATORS:** Drs. V. Lieffers and R. Rothwell, University of Alberta

**OBJECTIVES:** Evaluate differences in the rate of warming between drained and undrained peatlands during the growing season.

Determine if the onset of growth and development of trees and shrubs is earlier on drained or undrained peatlands.

**ACHIEVEMENTS:** Two plots, one drained and the other undrained, have been established near the Saulteaux River in the Slave Lake Forest. Black spruce, tamarack and dwarf birch study trees have been tagged for study.

Evidence indicates that the plot establishment in the drained site is intrinsically poorer than the plot established in the undrained site based on historical growth rates.

Drained peat was found to be warmer than undrained peat during this first year of the study in spite of persistence of the frost layer later in the summer in the undrained peat.

No significant differences in flowering behaviour were detected between the drained and undrained sites for any of the species examined, nor for any other phenological indicators with the exception of shoot elongation in black spruce, which was earlier on the drained plot.

**FUTURE WORK:** The monitoring of the plots will continue.

**FUNDING:** Contract funding from the Forest Research Branch.

## 3.0 ECOLOGY STUDIES

### 3.1 A DRAINAGE-GROWTH CLASSIFICATION SYSTEM OF ORGANIC SOILS IN ALBERTA

**JUSTIFICATION:** There are no guidelines currently available on the type of peatland which would provide the best growth response if drainage is carried out.

**INVESTIGATORS:** Drs. R.L. Rothwell and A.K. Hellum, University of Alberta

**OBJECTIVES:** Develop a classification system for assessing the potential for draining peatlands based on their vegetative characteristics.

**ACHIEVEMENTS:** Vegetation data were classified using a two-way indicator species analysis, TWINSPAN. This resulted in the delineation of eight vegetation groups. Two major groups were distinguished, transitional rich fens and meso-eutrophic fens. Meso-eutrophic fens had sufficient soil nutrients for sustained forest growth. These fens were classified in vegetation groups which had pure larch (Larix laricina) cover, or an admixture of black spruce (Picea mariana) with the larch.

Transitional rich fens had an average surface water pH of 6.66 and total peat nitrogen values under 1.3%. Forest cover on these sites was predominantly black spruce.

A MSc. thesis has been completed and successfully defended.

**FUTURE WORK:** The study is completed.

**FUNDING:** Forest Development Research Trust Fund.

## 3.2 COMPARISON OF ASPEN PARKLAND AND LOWER BOREAL BIOGEO-CLIMATIC ZONES OF NORTH-WESTERN ALBERTA

**JUSTIFICATION:** Site classification is not only a useful tool for various forest land management practices, but also

provides a sound basis for land use allocation decisions.

**INVESTIGATOR:** Dr. J. Snyder, Grande Prairie Regional College

**OBJECTIVES:** Identify major plant associations in the Peace River aspen parkland zone.

Describe floristic and soil differences between lower boreal zone and aspen parkland plant associations.

**ACHIEVEMENTS:** Two distinct biogeoclimatic zones, aspen and boreal, were identified in the Peace River Region. A significant transition zone is present, but is variable and patchy.

The aspen zone is characterized by elevation below 600 m, dominance by Populus tremuloides or P. balsamifera either singly or mixed, ground cover of grasses with slight representation of mosses and lichens, and Luvisols and grassland soils such as Chernozems, Solods and Solonetzes.

The boreal zone is characterized by elevation above 750 m, dominance by Picea glauca with occasional P. mariana, Pinus contorta and Abies sp., abundant terrestrial mosses, and grasses either rare or absent. Brunisol is the most common soil type.

Elevations between 600 and 800 m are occupied by the transition zone which may be dominated by either Picea glauca or Populus tremuloides, with both grasses and mosses present and common on predominately Luvisol soils.

**FUTURE WORK:** The project is completed.

**FUNDING:** Contract funding from the Forest Research Branch.

## 3.3 CORRELATION OF GLOBAL AND NET RADIATION WITH EVAPOTRANSPIRATION ON A FORESTED WETLAND SITE IN NORTHERN ALBERTA

**JUSTIFICATION:** Knowledge of evapotranspiration rate is very important because it provides information on the water balance; indicating whether more or less moisture is used than is received in the form of rain and snow.

**INVESTIGATOR:** Dr. R.L. Rothwell, University of Alberta

**OBJECTIVES:** Establish a set of empirical relationships between total global shortwave radiation and water table fluctuations, and net radiation and evapotranspiration for a forested wetland site.

Use these relationships and attendant data as a basis for evaluation of existing methods for estimating evaporation from wetlands and/or develop a local method based on readily-available climatic data.

**ACHIEVEMENTS:** Daily solar radiation and daily net radiation data required for the study were collected.

The sampling program for climatic and groundwater parameters was completed.

**FUTURE WORK:** Data analyses and the preparation of the final

report will be completed.

FUNDING: Forest Development Research Trust Fund

## 4.0 PATHOLOGY AND ENTOMOLOGY STUDIES

### 4.1 ISOLATION AND CHARACTERIZATION OF ANTIFUNGAL SUBSTANCE(S) PRODUCED BY *Scytalidium uredinicola*, A HYPERPARASITE OF *Endocronartium harknessii*, WESTERN GALL RUST

JUSTIFICATION: The knowledge of active chemicals produced by the hyper-parasite of western gall rust fungus may provide opportunities to control the occurrence of that rust.

INVESTIGATOR: Dr. M.A. Pickard, University of Alberta

OBJECTIVES: Determine the ability of compound(s) produced by *S. uredinicola* to inhibit the germination of *E. harknessii* spores *in vitro*.

Isolate and purify the active compound(s).

Test the effectiveness of the compound(s) *in vivo* against western gall rust infected lodgepole and jack pines as a means of biological control.

ACHIEVEMENTS: Maltol (3-hydroxy-2-methyl-4-pyrone) was successfully purified from chloroform extracts of *S. uredinicola* strains C677 and 4149 grown in the lab. Maltol is a plant metabolite known to have antifungal and antibacterial

properties.

**FUTURE WORK:** The antifungal properties of Maltol will be tested on western gall rust and other fungi *in vivo*. The Maltol content of needles collected from western gall rust resistant and susceptible lodgepole pine trees will be determined to find out whether Maltol concentration provides an indication of rust resistance.

**FUNDING:** Forest Development Research Trust Fund.

## 4.2 PATHOLOGICAL AND PHYTOCHEMICAL STUDIES OF *Armillaria* ROOT ROT OF INTENSIVELY MANAGED YOUNG CONIFEROUS FORESTS IN ALBERTA

**JUSTIFICATION:** *Armillaria* root rot is a common disease in young coniferous stands. It is already known that there are several geographic races of this fungus. Some of the races are causing higher mortality to conifers than others. The distribution of fungal races and their ability to cause mortality are vital information to silviculturists in terms of species and site selection.

**INVESTIGATORS:** Drs. Y. Hiratsuka and W.A. Ayer, University of Alberta.

**OBJECTIVES:** Determine whether weakening of the tree is necessary for disease to be expressed.

Evaluate the possibility of a relationship between the distribution of the pathogen and the disease in several selected sites.

Identify biologically active metabolites produced by the pathogen.

**ACHIEVEMENTS:** Sharpened trembling aspen poles, known as trap logs, were driven into the ground at each of three sites in the upper boreal subzone near Hinton, Alberta to test the technique as an indicator of Armillaria infection. The same form of Armillaria root rot was found on isolates from the trap logs and the trees at the one site where the trees showed symptoms of Armillaria infection, but no evidence of Armillaria infection was found on the trap logs on the two sites where the trees showed no indication of infection.

The results to date indicate that the trap log method is a promising technique for the detection of Armillaria root rot fungus in forest soils.

A PhD. thesis based on the results of this study has been completed.

**FUTURE WORK:** Comprehensive records of the distribution of Armillaria root rot in Alberta will be compiled. The records will be organized to relate the biological species of the pathogen complex to host tree species and forest type.

The relative aggressiveness with which Armillaria infected host trees, and the preferred host tree species

will be determined.

The morphological basis for species identification will be described.

**FUNDING:** Forest Development Research Trust Fund.

## 4.3 CHEMICAL COMMUNICATION (PHEROMONE) SYSTEM OF MOUNTAIN PINE BEETLE AND APPLICATION OF THE NATURAL PHEROMONE AND SYNTHETIC ANALOGS IN BEETLE MANAGEMENT

**JUSTIFICATION:** Chemical control of mountain pine beetle infestation is difficult and unacceptable from the environment point of view. The application of pheromones provides an opportunity for early detection of infestation and luring beetles into certain areas where they can be destroyed.

**INVESTIGATORS:** Drs. H. Wieser and E.A. Dixon, University of Calgary

**OBJECTIVES:** Evaluate the response of beetles to various structurally-related synthetic analogs of beetle-produced compound.

Determine if any analogs tested provide a more potent attractant.

Determine whether the sex ratio shifts in favor of males or females.

Find relationships between molecular structure and attractive response for beetles in the field.

**ACHIEVEMENTS:** The method of tree baiting to monitor beetle populations was found to work very well under low population levels.

When exo-5,7-dimethyl (e57D) analog is used in conjunction with trans-verbenol and myrcene compounds in baited traps for capturing mountain pine beetles in lodgepole stands the results were superior to those obtained using the natural pheromone component exo-brevicomin (eB). However, when e57D is used as tree baiting near epidemic conditions it appeared that eB was more effective.

The pheromone formulations which have proven successful for lodgepole pine beetle population were not effective for limber pine beetle populations.

A very promising route has been discovered for the synthesis of e57D which can be adopted for commercial scale production.

**FUTURE WORK:** Definition and quantification of the release rates of eB and the synthetic substitute of e57D will be concluded.

Identification and isolation of chemicals contained in the body parts of mountain pine beetles grown in limber pine will be carried out, and bait formulations for trapping or tree baiting in limber pine will be prepared.

**FUNDING:** Forest Development Research Trust Fund

# 5.0 WILDLIFE INTERACTION STUDIES

## 5.1 CRITICAL RESOURCES OF WAPITI IN THE BOREAL FOOTHILLS REGION OF ALBERTA

**JUSTIFICATION:** The effect of logging and reclamation activities on elk habitat is not known in the boreal foothills of Alberta. This study provides information about how the changed environmental conditions affect the elk population.

**INVESTIGATORS:** Dr. R.H. Hudson, and C.D. Olsen, University of Alberta

**OBJECTIVES:** Determine the seasonal ecological strategies of boreal wapiti with emphasis on the description of occupational patterns and foraging behaviour.

Identify critical habitat and forage resources.

Assess the contribution of reclamation habitat to the seasonal nutrient cycle.

**ACHIEVEMENTS:** Representative habitat sites were identified during summer movement. The foraging habits of wapiti were observed and forage samples were collected for identification.

Nutritional and digestibility studies were carried out at the University of Alberta Farm.

**FUTURE WORK:** Winter trapping will be carried out to attach radio collars to captured wapiti for subsequent radio tracking.

Opportunistic and systematic track surveys will be conducted. These surveys will include data collection on foraging, food habitat, and movement.

Habitat descriptions will be refined, and study of forage availability and fecal pellet collections will continue.

**FUNDING:** Forest Development Research Trust Fund .

## 6.0 WATERSHED MANAGEMENT STUDIES

The program of research into watershed management is a coordinated and cooperative examination of the question of whether forest harvesting in the Eastern Slopes of Alberta's Rocky Mountains presents a serious threat to the salmonid productivity and watershed value of the streams.

The individual projects are being conducted under contract from the Forest Research Branch and by Branch personnel. Agencies cooperating are: Forest Land Use Branch, Alberta Fish and Wildlife Division, Alberta Environment, Alberta Environmental Centre Vegreville, Environment Canada, and Alberta Research Council.

### 6.1 POPULATION DYNAMICS FOR MAJOR SALMONID SPECIES

**JUSTIFICATION:** Productivity of salmonid species in the Tri Creeks Experimental Watershed is the most direct measure of the possible effects of timber harvesting. This study will provide quantitative population dynamics data on the target

species: rainbow trout and Dolly Varden (Bull Char). It will also examine the effectiveness of the current groundrule requirement for a protective buffer strip of streamside timber in protecting the stream habitat.

**INVESTIGATOR:** G. Sterling, Alberta Fish & Wildlife Division

**OBJECTIVES:** Establish the magnitude and variation of salmonid population parameters before and after pulpwood harvesting.

Determine the effects of sedimentation on fish populations.

Examine water temperature and chemical composition in the study streams.

**ACHIEVEMENTS:** Initial results indicate slight increases in stream water temperatures and in suspended sediments following harvesting. Neither dissolved oxygen nor pH showed significant changes. Fry recruitment remained at pre-logging levels in most study sections. It was determined that stream flow accounts for approximately 85% of the variation observed in yearly cohort strength.

Data summarization and tabulations of field observations were added to the current volumes of Tri Creek data summaries.

**FUTURE WORK:** Field research will be concluded at freeze-up in 1985, although related studies will continue for one more season. Work in 1985 will include mark and recapture sampling and population sampling, and spawning and recruitment studies.

## 6.2 SITE CLASSIFICATION

**JUSTIFICATION:** A detailed forest site classification is necessary to provide the context within which to evaluate the integrated studies of the Tri Creeks Experimental Watershed, and to provide a guide for future forest management to ensure that the forest base is maintained in a productive condition.

**INVESTIGATOR:** Ms. S. Robertson, Resource Evaluation Branch, Resource Evaluation and Planning Division

**OBJECTIVE:** Characterization and mapping of the biogeoclimatic zones and plant associations of the Tri Creeks Experimental Watershed.

**ACHIEVEMENTS:** Preliminary field surveys, aerial photography and base mapping were completed during 1984.

**FUTURE WORK:** During 1985 the Experimental Watershed will be characterized in terms of plant associations and mapped on the basis of existing data from the pre-logging period and new field information. A final report is expected by March 31, 1986.

## 6.3 SOILS MAPPING

**JUSTIFICATION:** Suspended solids in streams are derived from either channel materials through resuspension, or from

upland areas by soil erosion. The erosion characteristics of a terrain and the hydrochemical effects of erosion are a function of forest soil properties. Therefore it is necessary to carry out a detailed inventory of soil types, including the physical and chemical character of each type. In addition, it is necessary to map the locations of sites prone to erosion or mass wasting.

**INVESTIGATOR:** G.M. Greenlee, Alberta Research Council

**OBJECTIVES:** Provide a detailed inventory of soil types, including physical and chemical characteristics.

Map locations of sites prone to erosion or mass wasting.

Select an erosion simulation model.

**ACHIEVEMENTS:** A detailed soil survey of the Tri Creeks Experimental Watershed was completed. Observation of existing erosion indicated that most erosion was occurring in areas where natural forest cover was disturbed sufficiently to allow surface water erosion.

Maps of potential erodibility were developed based on the soil erodibility, and a combination of slope length and gradient used in the Universal Soil Loss Equation. There was little variability in the erodibility of A horizon materials throughout the basin. These were generally classified as moderately erodible. The sub-soil materials (B and C horizons), however, exhibited a greater range in

erodibility.

**FUTURE WORK:** The final report is due in August, 1985.

### 6.4 SEDIMENT REGIME STUDY

**JUSTIFICATION:** Sediments in the streams, both suspended and settled, have an affect on the carrying capacity of the stream and on fish reproduction.

**INVESTIGATOR:** Dr. H. Hudson, Alberta Research Council

**OBJECTIVES:** Determine the influence of clearcutting on basin sediment yield during the open water period.

Determine the influence of clearcutting on the annual and storm sediment hydrographs.

Assess the efficacy of buffer strips as erosion control factors.

**ACHIEVEMENTS:** Daily data was collected from six sites during the spring runoff and storm season. Sampling frequency was reduced to alternate days during July and again reduced to twice weekly in August. Sampling was stopped by freeze-up on October 2, 1984. During storms hourly sampling was attempted using both automatic samplers and manual methods.

**FUTURE WORK:** Data collection will continue for two more seasons. A dynamic erosion, transport, and sedimentation

numerical model is being constructed. The Tri Creeks data will be used for calibration and validation of the model which will form a part of the final report. Additional suspended load sampling stations will be established upstream and downstream from mapped erosion sites. Data will be collected during storm events at these sites.

## 6.5 HARVESTING AND SILVICULTURE STUDIES

**JUSTIFICATION:** It is necessary for the completion of the final report to provide information on the harvesting operations and silviculture activities conducted by St. Regis (Alberta) Ltd. in the Tri Creeks Experimental Watershed.

**INVESTIGATORS:** Staff of the Edson Forest

**OBJECTIVES:** Document and assess the forest harvesting and silvicultural operations that were carried out in the Tri Creeks Experimental Watershed.

Compare these operations to the same type of operations applied to similar nearby watersheds to determine how representative the results from the Tri Creeks Experimental Watershed may be expected to be.

**ACHIEVEMENTS:** Forest harvesting and silvicultural operations were completed by freeze-up in 1984. A draft final report was received by the Study Director on January 15, 1985. Conclusions were that logging and silvicultural treatments in the experimental watershed were typical examples of treat-

ments in the St. Regis FMA with the following exceptions: Streamside vegetation was removed in the Deerlick Basin, which is not now done operationally; the proportion of timber removed in the experimental watershed was about double the usual amount; and, road reclamation in the experimental watershed was much more intensive than normal.

**FUTURE WORK:** The study is complete and no further work is planned.

## 6.6 WATERSHED MANAGEMENT PRACTICES

**JUSTIFICATION:** In order to make recommendations it is necessary to determine if the watershed management practices that have been applied to the Tri Creeks Experimental Watershed achieved the intended goals.

**INVESTIGATOR:** P. Jablonski, Forest Land Use Branch

**OBJECTIVES:** Document and assess the watershed management operations that have been applied to the Tri Creeks Experimental Watershed.

**ACHIEVEMENTS:** A project design was completed in late 1984 and initial staff work done to assemble information on pre-1983 operations.

**FUTURE WORK:** A field assessment of the effectiveness of soil

conservation measures applied during the after logging will be carried out in 1985.

## 6.7 HYDROMETROLOGY PROJECT

**JUSTIFICATION:** All the researchers concerned with the Tri Creeks Experimental Watershed require streamflow data collected to reliable standards.

**INVESTIGATORS:** M. Spitzer, Environment Canada; J. Coles, Alberta Environment; and D.T. Sneddon, Forest Research Branch

**OBJECTIVES:** To maintain a record of water discharge for each stream in the Tri Creeks Experimental Watershed.

**ACHIEVEMENTS:** preliminary assessment of stream metering data was completed during 1984. An intense daily routine metering schedule was pursued at all six stations during the spring and early summer, and twice weekly during the late summer and autumn low flow periods. Winter flows are being observed weekly.

This intensive measurement series will be used in conjunction with the gauging data to assess the overall accuracy and precision of the procedures. It will also be used to assist with the design of a monitoring strategy for the Watershed Section of the Forest Land Use Branch.

**FUTURE WORK:** The existing network of six stations will be

maintained until October 1986. It is likely that the three basin outlet stations will be maintained by Alberta Environment as part of its regional small basin monitoring program.

## 6.8 POOL VOLUME ESTIMATION PROJECT

**JUSTIFICATION:** It is thought that harvesting will have an effect the characteristics of stream beds over a period of time, particularly during the winter. The effects of the experimental harvesting on the hydraulics of the pool-run-riffle sequence of typical East Slopes streams will be used to develop a model that will simulate the observed changes.

**INVESTIGATOR:** Dr. R.A. Harrington, Alberta Research Council

**OBJECTIVES:** Determination of the effects of forest harvesting on the evolution of meander pools over time.

Develop a hydraulic model of changes in the stream bed configuration.

**ACHIEVEMENTS:** Six sets of pools, three each on Wampus Creek and Deerlick Creek, were surveyed from before freeze-up in September through break-up in April. Each observation consisted of a set of levels taken from permanent bench marks set up in the summer to the ice surface, the water surface, and the bed of the stream. At the request of Fisheries research staf, dissolved oxygen was also observed.

**FUTURE WORK:** Observations will continue for one more winter and the results from 1984 will be interpreted in time for

the 1985 annual report of the program.

## 6.9 CHANNEL REGIME PROJECT

**JUSTIFICATION:** In order to evaluate the effects of forest harvesting on Rainbow trout habitat it is necessary to determine the effects of harvesting on stream channel stability.

**INVESTIGATOR:** Dr. D.D. Andres, Alberta Research Council

**OBJECTIVES:** Assess the stability of stream channel morphology in plan, cross-section and longitudinal profile over the long term following harvesting.

Evaluate the utility of streamside timber as stream-bank protection following harvesting.

**ACHIEVEMENTS:** A pre-harvest assessment was carried out in 1975. The first data base exists to apply the regime equations of Blench and Lacey. A final report is expected in February of 1987.

**FUTURE WORK:** Two additional years' data will be required before an adequate data base exists to apply the regime equations of Blench and Lacey. A final report is expected in February of 1987.

## 6.10 HYDROLOGIC REGIME STUDY

**JUSTIFICATION:** Experiments will be carried out which will

compare annual basin water yields before and after harvesting using the paired basin approach to help establish the influence of harvesting on water yield. The effects of harvesting on storm hydrographs will also be examined.

**INVESTIGATORS:** Drs. R.A. Harrington and H. Hudson, Alberta Research Council

**OBJECTIVE:** Describe spatial and temporal distribution of surface water during normal and storm runoff periods.

Compare the water runoff regimes on streams fed by unharvested and harvested watersheds.

**ACHIEVEMENTS:** A literature review was begun and temporary gauges were installed at two points in Deerlick Basin.

**FUTURE WORK:** Numerical models, in particular the PROSPER (WRENSS) and SED models will be evaluated for sensitivity and applied to the Tri Creeks data. Water and energy balances will be attempted from historical data.

Three additional streamflow recorders will be installed, two on the main stem of Deerlick Creek between the existing gauges, and one on the East branch of Upper Eunice Creek. These gauges will be used to help establish the dynamic characteristics of these reaches, and to assess the amount of water entering the system as lateral groundwater inflow.

## 6.11 SURFACE WATER THERMAL REGIME

**JUSTIFICATION:** Rainbow trout spawning success, growth and survival depend heavily on the temperature of the streams they inhabit. It is therefore important to determine the effects of harvesting on stream temperatures.

**INVESTIGATOR:** Dr. A.H. Harrington, Alberta Research Council

**OBJECTIVES:** Determine the effects of clear-cutting both with and without buffer strips on the thermal energy balance and longitudinal temperature profiles of streams.

**ACHIEVEMENTS:** A study design was agreed to and a literature review was initiated.

**FUTURE WORK:** Two pyranometers will be established in the field early in 1985 to allow about two years of global incoming solar radiation to be collected. In the summer and fall, arrays of short-wave sun sensors will be established throughout the study area to determine the relationship between global radiation reaching the top of the forest canopy and the amount of energy reaching the stream surface.

## 6.12 HYDROCHEMICAL REGIME STUDY

**JUSTIFICATION:** The dissolved ion and nutrient content of the water in streams is known to influence the spawning success

and survival of Rainbow trout.

**INVESTIGATORS:** M. Korchinsky, Alberta Environmental Centre Vegreville and D.T. Sneddon, Forest Research Branch

**OBJECTIVES:** Determine the pre-harvesting hydrochemical regime in study streams.

Determine the post-harvesting hydrochemical regime in study streams.

Assess the effect of any changes on Rainbow Trout biology in the streams.

**ACHIEVEMENTS:** All baseline data collected prior to 1975 has been critically assessed to determine if they would be useful for the study. Several data sets were abandoned as uninterpretable, but the remainder will be included in the program for comparison with post-harvest data. Some of the retained data have required modification to be made comparable. Sampling methods were evaluated and found to be adequate. An agressive quality control program was initiated in cooperation with the Technical Development Branch of Alberta Environment. Plans for using automatic samplers were made for 1985, and two vacuum samplers were borrowed from the Kananaskis Centre for Environmental Research, University of Calgary.

Studies on sample changes with time, sample transportation methods, conductivity and pH variations in space and time, turbidity measurement, and suspended solids measurement

were also conducted.

**FUTURE WORK:** Software for assessment of water chemistry analyses is under development at Alberta Environmental Centre, Vegreville.

Collection of time series data at the basin outlet stations will continue until October 1986. In 1985 field determinations will be limited to pH, conductivity, CaII, total and phenol alkalinity, tannins and lignins, turbidity, and suspended solids (non-filterable residues).

Field parameters will be analyzed twice weekly during the spring runoff and storm periods, and once weekly during low flows. An attempt will be made to sample tributaries during storms and at least once during the summer low flow period when average specific conductivity exceeds 200 uS/cm. This data will help locate the source or sources for the major ions, nutrients, and metals within each basin.

## 6.13 HYDROGEOLOGICAL REGIME STUDY

**JUSTIFICATION:** Base flow and the largest portion of dissolved ions and nutrients in the study streams is derived from groundwater. The contribution of deep groundwater flow was established by D.V. Currie in 1972 for the study area. It remains to determine the contribution of shallow groundwater.

**INVESTIGATORS:** M. Trudell, Alberta Geological Survey, and

D. Prosser, Alberta Environment

**OBJECTIVES:** Assess the relative contribution of shallow (1-3 m) groundwater flow systems to streamflow.

Assess the impact of forest harvesting on both shallow and deep flow systems.

Characterize the relationship between subsurface and surface water temperatures.

**ACHIEVEMENTS:** Seven new piezometer nests were installed in 1984. One nest consisting of two standpipes in the Upper Eunice Creek basin, two of three standpipes each in the Deerlick Creek basin, and one with three standpipes and three with two standpipes each in the Wampus Creek basin.

Data from these new installations and the existing network were observed at weekly intervals. Hydrochemistry samples were analysed from selected springs and wells during the August low flow season. Isotope analysis sampling was conducted at the same time.

**FUTURE WORK:** Weekly water level observations and seasonal hydrochemistry, including isotopes, sampling will continue through August, 1986. A final report is due in February, 1987.

## 6.14 SNOW HYDROLOGY STUDY

**JUSTIFICATION:** Forest harvesting has been found to increase

the amount of runoff from snow, and to change the peak flows in a number of areas. It is necessary to determine if the same phenomena occur in the Tri Creeks Experimental Watershed.

**INVESTIGATORS:** Dr. R. Swanson, Canadian Forestry Service, and A. Nip, Forest Research Branch

**OBJECTIVES:** Assess the validity of the Region 4 data from the Water Resources Evaluation of Non-point Silvicultural Sources (WRENSS) procedure for application to the Tri Creeks Experimental Watershed.

Determine the timing and amount of water release from the snowpack in the Tri Creeks Experimental Watershed.

**ACHIEVEMENTS:** A network of four intersecting snow courses was established in a 37.8 ha, recently harvested block in the Upper Wampus Creek Drainage. Beginning in December 1983 measurements of snow depth, density and water equivalent have been obtained from the snow courses.

A paper on the study design and progress was presented to the Snow Measurement Workshop in Lake Louise on April 2, 1985.

**FUTURE WORK:** Data will be collected for one more winter and a final report will be submitted to the Director by July 31, 1986.

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## EMPLOYEES OF FOREST RESEARCH BRANCH

| EMPLOYEE | POSITION |
|---|---|
| J. Soos (Joe) | Director |
| Dr. S. Navratil (Stan) | Research Manager, Regeneration |
| D.T. Sneddon (Tom) | Research Manager Watershed |
| J. Fochler (Jerry) | Forester, Regeneration |
| A. Nip (Al) | Research Officer, Watershed |
| T. Mueller (Ted) | Forest Officer, Regeneration |
| R. Sidor (Reitha) | Office Manager |
| R. Bouchard (Rhonda) | Secretary |